IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of: **BALLATO et. al**
Application Serial No.: **10/774,645**
Application Filed: **February 2, 2004**
Attorney Docket No.: **CECOM 5486**
For: **LATERAL FIELD EXCITATION OF BULK ACOUSTIC WAVES FROM AN IC-COMPLIANT LOW VOLTAGE SOURCE**

Madame:

These Remarks are submitted in support of amending the above-identified application.

REMARKS

Claims 1-47 are now in the case. No new claims have been added. Claims 8, 9, 34 and 35 have been canceled.

Separate Amendments To The Claims, Amendments To The Specification and these Remarks are enclosed with this Amendment.

This Amendment responds to the first Office Action in this case wherein the Examiner objected to the drawings, informalities in the specification and informalities in claims 15 and 25 and 10-14, 16-21, 29-31 and 37-47 due to lack of clarity. The Examiner also rejected claims 1-47 under 35 U.S.C. § 102(b) as being anticipated by Yamanouchi Japanese Patent 9-260993 based upon that patent teaching similar structural elements.

Each objection, rejection and response is set forth in more detail below. The present Amendment provides corrected drawings for FIG'S 1C and 2A-2F, revises specification informalities and amends or cancels the objectionable claims. This Amendment also revises and clarifies rejected claims 1-47 to more particularly point out and distinctly claim this invention's interdigital lateral field excitation Bulk Acoustic Wave transducers in a way not anticipated by the cited prior art. It is respectfully submitted that submission of corrected drawings, correcting objectionable specification passages and claims and clarifying and revising the rejected claims 1-47 overcomes and obviates the Examiner's objections and rejections. It is respectfully requested that the Examiner reconsider the objections and rejections and that claims 1-47, as amended, be

allowed and pass to issue.

This Amendment includes corrected drawing replacement sheets for FIG'S 1C and 2A-2F, which are now designated with a "Prior Art" legend. The Examiner also objected to informalities in the specification at page 4, line 19 to page 5, line 6, due to the misspelling of the word "ratios" and at specification at page 10, line 30 by not including the symbol "Å," both of which have now been corrected in the Amendments To The Specification.

This Amendment also corrects objectionable claim informalities in claims 5 and 25 and claims 10-14, 16-21, 29-31 and 37-47. The Examiner objected to claims 5 and 25 because it was unclear what was claimed by the expression "$L_1 + L_2 - W$." Claims 5 and 25 have been revised to recite interdigital lateral field excitation bulk acoustic wave transducers with an active region having an electrode overlap width measured by the formula $L_1 + L_2 - W$, which is disclosed on specification page 9, lines 11-13. The Examiner also objected to informalities in claims 10-14, 16-21, 29-31 and 37-47 based on lack of clarity for the expressions "first one" and "second one." It is respectfully submitted that these terms refer to electrodes and that revising the claims to refer to the first and second electrodes of the combs is adequately supported by FIG. 3 and specification page, 14 lines 4-19, which disclose first and second combs of IDT electrode fingers and "...aligning a first one of the first comb and a second one of the second comb into a pair, positioning the first one and the second one parallel and proximate to one another and having an opposite polarity and an acoustic impedance matching the substrate acoustic impedance, the pair further comprising a period..." Claims 10-14, 16-21, 29-31 and 37-47 have been revised accordingly and conforming revisions have also been made to claims 3, 4, 8-9, 22-24, 31 and 34-35. It is respectfully submitted these clarifying revisions to claims 1, 3-5, 20 and 22-24 overcome and obviate the Examiner's objections to the claim informalities without adding any prohibited new matter.

Additionally, independent claims 1, 21 and 31 have also been clarified, corrected and revised to more particularly point out and distinctly claim this invention's interdigital ("IDT") lateral field excitation bulk acoustic wave ("BAW") transducer devices, apparatus and methods. It is respectfully submitted that these corrections and revisions are adequately supported by the specification and do not constitute prohibited new matter. The claim 1 preamble has been

clarified to recite an IDT lateral field excitation BAW transducer. As discussed above, the offending phrases a "first one" and a "second one" in line 9 have been revised to recite a first electrode of the first comb and a second electrode of the second comb, which is also adequately supported by the preceding recitals of claim 1, as well as FIG. 3 and specification page 14, lines 4-19. Claim 1, lines 23-26 has been clarified to recite the positioning of the first and second electrodes within each period as being an additional factor in generating the low-voltage, lateral field excitation BAWs of the present invention, which is adequately supported by specification page 4, lines 25-30, as follows:

> These and other objects and advantages can now be attained by this invention's Interdigital Bulk Acoustic-Wave Transducer (IBAT), comprising pairs of exciting electrode fingers disposed sufficiently close together on the piezoelectric substrate and dielectric coating over the exciting electrode fingers to generate an IC-compatible voltage at relatively high electric field strength, resulting in a reduced region of excitation and uniform electric field strength distribution. (Emphasis Supplied)

Also, the term "Bulk Acoustic Wave" has been capitalized wherever it appears in the claims. Similar revisions were also made to independent claims 21 and 31. Other clarifying revisions to the claims include inserting "and" in claims 6, 26 and 32 and deleting the duplicative phrase "further comprising" from claim 28. It is respectfully submitted that the claims, as amended, have been clarified, corrected and revised without adding any prohibited new matter.

The Examiner rejected claims 1-47 under 35 U.S.C. § 102(b) as being anticipated by Yamanouchi Japanese Patent 9-260993 based upon the Yamanouchi patent reciting a number of similar structural elements. According to the Examiner, the Yamanouchi patent teaches a surface acoustic wave with first and second sets of interdigital electrodes 2 and 3 (of the Yamanouchi FIG. 1) deposited on substrate 1, wherein the first comb positive electrodes are connected to a first bus bar and the second comb negative electrodes are connected to a second bus bar 2a and 2b. The Yamanouchi patent also discloses a dielectric coating covering a portion of the electrodes and a portion of a gap formed between the electrodes. The Examiner concluded that this invention's structure is the same as the Yamanouchi device and that a lateral field excitation should be expected from the Yamanouchi device. The Examiner also stated that claims 2-7 were

anticipated by the prior art, claims 8-9 are inherent in the prior art and that claims 10-21 are anticipated by the prior art teaching the dielectric coating covering part of the electrode and part of the gap. These rejections are hereby traversed.

Before responding to the Examiner's prior art rejection, applicant's attorney wishes to describe the IDT lateral field excitation BAW transducer as recited by the amended claims. Claim 1, as amended, now recites an IDT lateral field excitation BAW transducer, comprising a first comb of interdigital electrode fingers deposited on a surface of a piezoelectric substrate that interleaves with an opposing second comb of interdigital electrode fingers; the first and second combs being conductive and connected to a first and second bus bar, each comb defining an active region on the surface, with the piezoelectric substrate having a substrate acoustic impedance; paired electrodes of each comb forming a period, with an opposite polarity and an acoustic impedance matching the substrate acoustic impedance, each period having a period gap, G1, separating the first and second electrodes, and electrode edges separated by an electrode gap, G2, which is wider than, and parallel to, period gap G1. A portion of each period is covered by a dielectric coating. An exciting AC voltage placed across the period generates lateral electrical fields that alternate in polarity and piezoelectric mechanical surface tractions are produced at the electrode edges; the alternating lateral electrical fields, multiple periods, dielectric coating and close positioning of the first and second electrodes in each period generate a low-voltage, planar, lateral field excitation bulk acoustic wave propagating away from the surface, with the bulk acoustic wave suppressing surface acoustic wave production. In accordance with the present invention, the BAW provides a lateral electric field with a constant magnitude substantially uniform over the active area, reduces electrode field intensity spikes, with a phase progression substantially parallel to the surface, and produces a number of spatially distributed lateral electric fields pointing substantially in a single direction over the active area. The dependent claims have also been revised with the new preamble and conforming changes relating to the first and second electrodes. Similar revisions have also been made to independent claims 21 and 31 and their dependent claims.

It is respectfully submitted that the IDT lateral field excitation BAW transducers of the present invention are not anticipated by the Yamanouchi patent under 35 U.S.C. § 102(b)

because that patent's device lacks a number of this invention's structural elements, operates in a completely different manner than this invention and solves a substantially different set of problems. Additionally, the Yamanouchi's drawings do not qualify as prior art under MPEP § 2125 Drawings As Prior Art because they do not depict a number of this invention's structural elements. Despite the apparent structural similarities described by the Examiner, there are such substantial and patentably distinct differences between the prior art and this invention's BAW transducers that the claims, as amended, should not be considered anticipated under 35 U.S.C. § 102(b). It is respectfully requested that the claims, as amended, be allowed and pass to issue.

It is respectfully submitted that this invention's IDT lateral field excitation BAW transducers are not anticipated by the Yamanouchi patent under 35 U.S.C. § 102(b) because that patent's device lacks a number of this invention's structural elements. Notwithstanding the apparent structural similarities described by the Examiner, there are such substantial and patentably distinct structural differences between the prior art and this invention's BAW transducers that the claims, as amended, should not be considered anticipated under 35 U.S.C. § 102(b). As best understood, the Yamanouchi device includes some similar structural elements such as interdigital electrodes, a substrate, the first comb positive electrodes being connected to a first bus bar, the second comb negative electrodes being connected to a second bus bar, a gap between the electrodes and a dielectric coating covering a portion of the electrodes and a portion of a gap. According to the Examiner, a lateral field excitation should be expected from the Yamanouchi device. Assuming arguendo that the Yamanouchi device discloses those cited structural elements, the Yamanouchi patent still fails to teach or disclose a number of this invention's structural elements.

The first significant structural difference is that this invention is a BAW transducer generating a low-voltage, planar, lateral filed excitation BAW propagating away from the piezoelectric substrate that suppresses a SAW. The Yamanouchi device generates Surface Acoustic Waves ("SAWs"). As a result, the electric field distributions in both devices differ. The Yamanouchi device having the SAW piezoelectric constant needed to generate a SAW, and not having a BAW piezoelectric constant needed to generate a BAW. By contrast, this invention's IDT lateral field excitation BAW transducers include the BAW piezoelectric constant

needed to transmit BAWs, and is missing the SAW piezoelectric constant needed for generating an SAW. Another significant structural difference is that this invention provides for dielectric coatings underneath the IDT electrodes, while the Yamanouchi device does not teach dielectric coating under the electrodes. Additionally, the Yamanouchi device does not teach the first comb of IDT electrode fingers being interleaved with an opposing second comb of IDT electrode fingers, each comb defining an active region on the surface of the piezoelectric substrate and the piezoelectric substrate having substrate acoustic impedance. Other structural differences include alternating polarity in lateral electrical fields, piezoelectric mechanical surface tractions produced at electrode edges and generating a low-voltage, planar, lateral field excitation BAW propagating away from the surface. Based on these structural differences, it is respectfully submitted that this invention is not anticipated by the Yamanouchi patent under 35 U.S.C. § 102(b).

It is also respectfully submitted that this invention's IDT lateral field excitation BAW transducers are not anticipated by the Yamanouchi patent under 35 U.S.C. § 102(b) because that patent's device operates in a completely different manner than this invention. As mentioned briefly above, the Yamouchi device makes SAWs and cannot produce a BAW, while this invention produces a BAW and suppresses the SAW.

In the Yamanouchi case, the IDT fingers produce electric fields with substantially equal strength, but opposite in direction, in alternate gap regions. These fields excite SAWs propagating in both directions, but mechanical perturbations, i.e. the repeated patterns of up's and down's of the dielectric films, produce destructive interference for SAWS in one direction, and constructive interference for SAWS in the other direction, resulting in a unidirectional SAW transducer. In all likelihood, the Yamanouchi material, cut and IDT orientation have been selected to not have a substantial BAW piezoelectric constant. Similarly, in this invention, the material, cut, and IDT orientation will be selected to not have a substantial SAW piezoelectric constant present. More importantly, the electrical properties of this invention's dielectric film cooperate with the IDT electrodes to produce a minimum of electrical field strength in one direction, and a maximum of electrical field strength in the other direction, the result being a substantially unidirectional electric field over the whole major surface, instead of equal-strength electric fields that alternate in lateral direction from one gap to the next in the usual IDT

arrangement. This invention's substantially unidirectional electric field is much stronger than the field produced by a single electrode pair at the plate edges, for the same applied voltage, as is usual for lateral-field operation. This invention's IDT lateral field excitation BAW transducer gains the virtues of lateral-field operation, and the ability to produce strong BAWs, using the relatively low voltages available on IC chips.

Another substantial operational difference is how the dielectric film coatings modify or influence propagation characteristics. The Yamanouchi SAW device deals exclusively with SAWs that propagate laterally along a single surface. The Yamanouchi film coatings modify the propagation characteristics of the SAWs by the various dimensions of the coatings in order to produce a unidirectional SAW and their acoustic impedance. By contrast, this invention deals exclusively with BAWs that propagate away from the plate surfaces with a phase progression substantially parallel to the surface. The Yamanouchi dielectric coating has the sole purpose of affecting propagation characteristics of SAW waves by changing acoustic impedance that the SAW waves see as they propagate laterally to the thickness direction. The Yamanouchi coating acts as an insulator instead of a dielectric coating. As best understood, the dielectric nature of the Yamanouchi coating does not influence its operation in that the coatings work irrespective of the film's dielectric constant. However, the dielectric coatings of this invention's IDT lateral field excitation BAW transducer are used for their dielectric properties in order to shape the electric field distribution by blunting sharp spikes and producing a lateral electric field pattern that is largely unidirectional. In summary, the Yamanouchi coatings are used for mechanical and geometrical purposes, while this invention's coatings are used for their dielectric properties. Based on these structural differences, it is respectfully submitted that this invention is not anticipated by the Yamanouchi patent under 35 U.S.C. § 102(b).

It is also respectfully submitted that this invention's IDT lateral field excitation BAW transducers are not anticipated by the Yamanouchi patent under 35 U.S.C. § 102(b) because that patent's device solves a substantially different set of problems than this invention. The Yamanouchi Abstract identifies the problem to be solved as:

> To unidirectionally convert a ...SAW...while using excitation due to an electrode and the reflection characteristics of a dielectric thin film by forming grating-like reflector

on the surface of the dielectric thin film stuck on the surface of an interdigital electrode. This invention solves a completely different set of problems. Prior art resonators never used an IDT to purposely generate plane-wave BAWs that propagate away from the substrate surface, and any such BAWs previously generated by an IDT were weak, spurious and detrimental.

Specification page 3, line 16 to page 4, line 7, states:

> To overcome the disadvantages, shortcomings and limitations of the prior art resonating structures, there has been a long-felt need to provide a planar electrode structure that is both IC-compliant and able to be energized by a low-voltage source... Prior art LFE electrode configurations employ individual electrode pairs ... on, or ... in, a resonant substrate, causing a relatively large separation. The present inventors have developed a quite different technique for resolving ... inadequate excitation strength and non-uniform power distribution.
>
> The present invention provides an ... IDT structure to generate BAWs by modifying the IDT with dielectric structures to make the IDT capable of generating BAWs efficiently. Instead of depositing two electrodes exposing a large fraction of the active area of the resonant structure to the exciting electric field, this invention provides for depositing two exciting IDT electrode structures with finger spacings for LFE sufficiently close together on the piezoelectric substrate to cause a voltage compatible with IC devices for a usefully high electric field strength, which results in a substantial region of excitation covered by the IDT finger structure so as to produce efficient transduction. (Emphasis Supplied)

Yamanouchi's purpose is to convert a SAW to a single direction, and this invention's purpose is to provide an IDT structure that generates a BAW efficiently by modifying the IDT with dielectric structures. As discussed more fully above, these different purposes are also reflected in structural and operational differences. Based on the significantly different purposes and problems to be solved, it is respectfully submitted that this invention is not anticipated by the Yamanouchi patent under 35 U.S.C. § 102(b).

It is also respectfully submitted that claims, as amended, are not anticipated by the Yamanouchi patent, because the figures that the Examiner relied upon for the rejection do not

show all this invention's claimed features, which is contrary to MPEP § 2125 Drawings As Prior Art . According to the Examiner, the Yamanouchi patent includes some similar structural elements such as a SAW with first and second sets of interdigital electrodes 2 and 3 deposited on substrate 1, wherein the first comb positive electrodes are connected to a first bus bar and the second comb negative electrodes are connected to a second bus bar 2a and 2b. The Yamanouchi patent also discloses a dielectric coating covering a portion of the electrodes and a portion of a gap formed between the electrodes, which are all depicted in Yamanouchi FIG'S 1-3. It is respectfully submitted that Yamanouchi FIG'S 1-3 do not depict all of this invention's claimed elements and otherwise lack sufficient features and details to qualify as prior art under MPEP § 2125. MPEP § 2125 Drawings As Prior Art describes when a drawing can be used as prior art as follows:

> Drawings and pictures can anticipate claims if they clearly show the structure which is claimed. In re Mraz, 455 F. 2d 1069, 173 USPQ 25 (CCPA 1972). However, the picture must show all the claimed structural features and how they are put together. Jockmus v. Leviton, 28 F.2d 812 (2d Cir. 1928)...When the reference is a utility patent, it does not matter that the feature is unintended or unexplained in the specification. The drawings must be evaluated for what they reasonably disclose and suggest to one of ordinary skill in the art. In re Aslanian, 590 F. 2d 911, 200 USPQ 500 (CCPA 1979)...
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> (Emphasis Supplied)

Assuming arguendo, that Yamanouchi FIG'S 1-3 depict the elements cited by the Examiner in her rejection, MPEP § 2125 Drawings As Prior Art requires that Yamanouchi FIG'S 1-3 "clearly show the structure which is claimed," including "all claimed structural features." It is respectfully submitted that Yamanouchi FIG'S 1-3 do not depict the following elements of the claim 1 IDT lateral field excitation BAW transducer:

a BAW transducer;

the first comb of IDT electrode fingers being interleaved with an opposing second comb of IDT electrode fingers;

each comb defining an active region on the surface of the piezoelectric substrate;

the piezoelectric substrate having a substrate acoustic impedance;

paired electrodes of each comb forming a period with an opposite polarity and having an acoustic impedance matching the substrate acoustic impedance;

electrode edges separated by an electrode gap, G2, which is wider than, and parallel to, the period gap G1;

an exciting AC voltage placed across the period generates alternating lateral electrical fields;

the alternating lateral electrical fields alternate in polarity;

piezoelectric mechanical surface tractions are produced at the electrode edges;

the alternating lateral electrical fields, multiple periods, dielectric coating and close positioning of the first and second electrodes in each period generate a low-voltage, planar, lateral field excitation BAW propagating away from the surface;

the BAW suppressing SAW production; and

the BAW provides a lateral electric field with a constant magnitude substantially uniform over the active area, reduces electrode field intensity spikes, with a phase progression substantially parallel to the surface, and produces a number of spatially distributed lateral electric fields pointing substantially in a single direction over the active area.

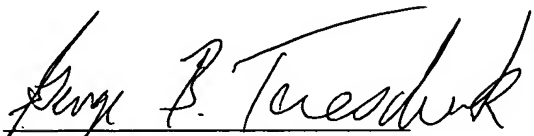
Since Yamanouchi FIG'S 1-3 do not depict numerous significant elements of the claimed invention, the Examiner's 35 USC § 102 (b) rejection appears to be contrary to MPEP § 2125 Drawings As Prior Art because those drawings fail to "clearly show the structure which is claimed," including "all claimed structural features." It is respectfully submitted that these drawings lack sufficient features and details to qualify as prior art under MPEP § 2125 Drawings As Prior Art. Similar discrepancies between claims 21 and 31, as amended, and Yamanouchi FIG'S 1-3 can also be readily made. It is respectfully requested that the Examiner reconsider the anticipation rejection under 35 USC § 102 (b) based on Yamanouchi FIG'S 1-3 because those drawings do not meet the requirements of MPEP § 2125 Drawings As Prior Art, and that the claims, as amended, be allowed and pass to issue.

In conclusion, t is respectfully submitted that this invention's IDT lateral field excitation BAW transducers are not anticipated by the Yamanouchi patent under 35 U.S.C. § 102(b) because that patent's device lacks a number of this invention's structural elements because it

generates SAWs instead of BAWs, operates in a completely different manner than this invention by producing SAWs instead of a BAW, solves a substantially different set of problems and the Yamanouchi's drawings do not qualify as prior art under MPEP § 2125 Drawings As Prior Art because they do not depict a number of this invention's structural elements. For these reasons, it is respectfully requested that the Examiner reconsider the 35 U.S.C. § 102(b) anticipation rejection, and that the claims, as amended, be allowed and pass to issue.

Should the Examiner require further information, the Examiner is invited to telephone the applicants' attorney at the telephone number listed below.

Respectfully Submitted,



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DATE

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